SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

INDUSTRIAL MUSEUMS AND EFFICIENCY[1]

ART and natural history are now represented in New York City by material equal to that collected in any of the chief centers of the Old World. More characteristically American, however, would be an adequate showing of our astounding agricultural, mineral and industrial wealth. The proper illustration of this could and should be given by a group of special museums, united under a common management, and working in thorough harmony for the common aim of national education. The special museums should be devoted to the following branches, each one of the institutions being complete in itself:

Electricity	Historic records
Steam	Health and hygiene
Astronomy and navigation	Textiles
Safety appliances	Ceramics and clays
Aviation	Architecture
Mechanical arts	Scenic embellishment
Agriculture	Horticulture
Mining	Roads and road-building materials
Labor	Commerce and trade
Efficiency	Printing and books

Fifty years ago there was no art museum, and no museum of natural history in this great city of New York. At the present time we have both, as well as a museum of safety, but the only technical art museum is that associated with the Cooper Union for the Advancement of Science and Art. This is a small, unique and valuable technical art museum founded by and

[1] From the address of the vice-president and chairman of Section I, Social and Economic Science, American Association for the Advancement of Science, New York meeting, December, 1916.

under the direction of the Misses Hewitt.

Industrial technical museums would give not only the employer and the foreman, but each workman, a knowledge of, and create an interest in his profession or trade, no matter how humble it may be. How many men know anything about the history, the development, the successive stages of the profession in which they labor or the material with which they work? How many bricklayers know anything about the origin of a brick, how it ought to be laid, how it will best hold? How many cement-mixers are there that thoroughly understand the fundamentals of cement and mortars, how they are made, and where obtained? Few carpenters and cabinet-makers know more than one or two woods, and those not thoroughly; whether a wood can be stained, or oiled; whether it is adapted to indoor work or outdoor work. Leather, one of our greatest commodities, is understood no better.

These, and all the lines of mechanics, electricity, etc., should be illustrated in such a way that the artisan would become more skilled. The result would be to raise the amount of his production, increase his earning capacity and make him less of a clock-time server. The production of the country would be correspondingly increased, greater resources being created with less effort. One should understand the industrial conditions of the country; where the resources are, and where they can be developed. Not only nations in Europe understand this about their neighbors, but some Asiatic countries as well.

In the preparedness for peace, we find a splendid field for the utilization of our projected museum of peaceful arts. There is a growing tendency to broaden and diversify our school system, by the introduction of many elements of instruction outside of the narrower school course and the school precincts, and this has found expression in the Gary plan, so successfully introduced in many places. Our museum of the peaceful arts would enable us to give a wide development to this phase of education. For we know that nothing impresses a child or a young person more strongly than a direct visual appeal. A complete concrete object set before children, adequately explained and, if possible, set to do its work before their very eyes, will be not only better understood by them, but also far longer remembered, than any wood-cut with a text-book elucidation can possibly be.

This real grasp of the matter will prove of inestimable importance when the young person begins to undertake practical work in the industrial or art calling which has been chosen. The rate of progress will be much more rapid and exact practical results will be much sooner attained than under the old system.

As so much depends upon the expansion of our foreign trade, especially in South America and in Asia, a great desideratum is that a certain number of our young men should be given a special training in this direction. Such a training could be best acquired by means of a commercial school-ship, which would make semi-annual trips to various parts of the world, stopping for a longer or shorter time at the principal foreign ports. The commercial students, under the direction of competent instructors in the various branches of trade, would thus have the opportunity to study all the commercial proceedings at first hand from actual observation. They could learn in the most impressive way all the difficulties encountered in passing goods through the various foreign custom-houses, how the goods should be packed, in what shape the foreign importer most likes to receive them, and what are the rules and practises of our

chief rivals in the export trade. "Book-learning" is singularly inefficient in such matters, however competent may be the writers of manuals and guides; only actual contact with actual conditions will ever impart the kind and quality of knowledge that go to build up a thoroughly successful export business. The pleasant conditions of such a trip, the bracing and animating effect of the pure ocean air in transit from port to port, during which the students would have ample time to think over and note down what had been learned, would make this an unforgettable period in any young man's life, a period in which the foundations of his future success had been laid.

FERTILIZER AND NITRATES—DRAINAGE AND IRRIGATION

Two great problems in the United States to-day are: First, Is not our land throughout the entire country gradually becoming poorer? Is not our yield per acre becoming less, except in a small percentage of the land where modern methods have been used? The second problem regards the fact that the great cities of the country are taking the product of the land and returning none of it to the land, only piling up garbage heaps which even when burned are lost to the land whence the original material was taken.

In regard to the waste of valuable fertilizers in the disposition of the refuse of our great city of New York, the present speaker, in 1912, used the following words in a paper read at a meeting of the American Museum Association in New York:[2]

> Here in the city of New York we are permitting 2,500,000 tons of refuse and human waste to go to the garbage heaps, to the sewers, and to pollute the rivers, at once spoiling a valuable source of food supply, and bringing disease to the inhabitants of the city, while if this material could be collected and spread over the barren fields of Long Island and New Jersey, these tracts might be made into garden spots of the earth. Furthermore, these same chemical products, after being turned into food and again into waste, could be utilized anew, thus constituting a kind of endless chain of usefulness. Furthermore, the waste of nitrates in urine alone represents over 50,000 tons annually.

[2] Presented by Dr. George F. Kunz at the International Conference relating to Program for Celebration of the Centenary of the Signing of the Treaty of Ghent, held in New York, May 9, 1913; p. 3 of reprint.

The unfavorable report of the United States Geological Survey on the nitrate deposits of this country clearly shows that in case of a sudden large demand arising from a state of war, this country must depend either upon the Chilean nitrate deposits, or upon nitrate derived from the atmosphere. The National Defense Act of June 3, 1916, contains an appropriation of $20,000,000 for the establishment of a plant for this purpose, and the European war has shown that a belligerent cut off from outside sources of supply can obtain at least part of the absolutely necessary nitrate, both for munitions and for agricultural fertilization, from the nitrogen in the air, although it has recently been stated on high authority that the great exponent of efficiency in Europe has been unable to provide a sufficiency for land fertilization, and that the productivity of the land is therefore decreasing rapidly.

If the United States government would establish three or more large depots of nitrate, so located as to be within easy reach of the various great agricultural complexes, storing a million tons or more in each one, the farmers would be able to supply their wants at will, and the government would be able to stabilize the price of the nitrate sold to them. The stocks could be constantly replenished, and would thus at once serve as a source of supply for agriculture, and also at a reserve for use in case of a possible war, when the boasted

freedom of the seas might be again subjected to violation.

The increased productiveness of the farm land would render it possible in case of war to enroll probably one third of the agricultural laborers in the army, or should their services not be needed, to use them for industrial enterprises or for the cultivation of additional land. How greatly the employment of nitrates as fertilizers has been increased in recent years is shown by the fact that while in the three-year period 1898–99, 10 per cent. of the nitrate of soda used in the United States was thus utilized, the figures for 1910–12 show an average agricultural use of 45 per cent., and in 1914 the percentage had risen to 55 per cent.

The necessity for doing something to stabilize the prices of nitrates is shown by the wide range they have shown during the past four years. The downward and upward trend of the price per ton in this period is reported as follows:

1913	$52.00	$43.00
1914	44.50	38.00
1915	37.50	80.00
1916	80.00	85.00

Thus the price toward the end of 1916 ($85) was more than twice what it had been at the beginning of 1915 ($37.50).

It is interesting to note that nitrate from the Chilean beds was already used by the Indians in the seventeenth century, both for fertilizing purposes and in the making of gunpowder.[3] The immense quantity of nitrate now taken by the United States and by European countries appears in the following figures, giving the consumption for the three-year period, 1910–12:

United States	1,509,700 tons
Continent of Europe	4,852,180 "
United Kingdom	381,960 "
	6,743,840 tons

[3] "The Nitrate Industry," by Señor Enrique Cuevas; pub. by Chilean Nitrate Propaganda, New York, 1916, p. 9.

The farmer who trusts to self-seeding of his land can use that land for pasture, but rarely for crops; whereas he who carefully sows his land, tills it, and enriches it, receives a splendid crop. As in the Parable of the Sower, some seed fell on good land, some on shallow land and rocky soil; some brought forth a hundred fold, and some blew away or was withered. So in the struggle of life, great men will sometimes arise from the lowest ranks in spite of all obstacles, but if many of these men had had some opportunities for development they would have attained their ends with infinitely less trouble and probably would have shown greater results.

The vital importance of carrying on drainage and irrigation work on an extensive scale becomes more and more apparent as the demand for agricultural products, both for home consumption and for export, becomes greater and greater. The public land still owned by the government, largely desert tracts awaiting irrigation, has been stated by Secretary Lane to have an extent of 250,000,000 acres. This constitutes a great and valuable reserve which must be utilized in the near future. For, even with the better fertilization, with the more intense cultivation so imperatively demanded, the rapid growth of our population and of the foreign demand make it necessary to enlarge our agricultural acreage to keep the prices of our stable products within reasonable bounds.

The reclamation of swamps is one of the most important problems of the present time. Many of the best lands of America are still in swamp form, and the sanitation produced if this land were reclaimed would more than pay for the work necessary, by the increased healthfulness of the country. The draining of the swamps is one of the best means of destroying the breeding places of the mosquito, and the extermination of the mosquito is one of the great

issues of the day. It was this extermination that made the Panama Canal possible, and has rendered Havana a justly favored health resort.

The acreage of unreclaimed and practically worthless swamp land in 1908, was stated by Hon. James Wilson, Secretary of Agriculture, to be 79,007,023 acres, and he estimated that reclamation would make these lands worth nearly $1,600,000,000, and that the value of their annual produce would amount to $273,000,000.

For the development of commerce, waterways play a most important part and the work done in this direction would fall in line with that carried on in drainage and irrigation. Our great natural waterways must be constantly supplemented, and their usefulness as channels of commerce must be increased. Nothing has so powerfully fostered the interior commerce of central Europe as the great canals uniting and extending the natural waterways, and in our own land we have striking examples of this. In such undertakings our citizen soldiery, with their special training, could be utilized in a way most valuable for the commercial interests of our land.

The great war has shown us what wonders scientific training can accomplish in destruction and devastation. Let us hope that the United States may continue to offer the world an object lesson of the value of peace arts, and that the magic wand of science may continue to be used by us for the works of peace, or, at the worst, for the defense of the freedom of our fair land against any and all ruthless aggression.

GEORGE F. KUNZ

SCIENTIFIC EVENTS

DECLINE OF GERMAN BIRTH RATE

THE Amsterdam correspondent of the London *Times* writes that although it is difficult to sift the truth from the reports which constantly reach Holland of increasing mortality in Germany, there is enough evidence in them to indicate a decline in the national vitality. Apart from causes connected with the war, there are others affecting the birth-rate to which attention is drawn by the German press, which comments on the "shameless" extent to which recourse is had to artificial means of restricting the natural growth of the population. Strong measures, it would appear, are being contemplated by the authorities to counteract the fatal effects of a policy of calculated sterility. In addition there is an enormous falling off in the number of marriages. In Berlin the number of marriages has been declining; in 1915 there were 16,622, and in 1916 13,966. With this decline there goes a decline of births and a large number of deaths.

The Amsterdam Bureau of Statistics in its weekly report compares the vital statistics of several large German towns with those of Amsterdam for the 10 weeks from November 5 to January 13. The following table, compiled from the Dutch figures, will be found instructive:

—	Amsterdam (Pop. 626,470)		Hamburg (Pop. 1,050,690)		Berlin (Pop. 1,798,962)	
	Births	Deaths	Births	Deaths	Births	Deaths
Nov. 5-11.....	255	126	179	403	387	744
Nov. 12-18.....	271	137	200	446	378	689
Nov. 19-25.....	259	143	118	422	415	736
Nov. 26-Dec. 2	279	131	196	417	370	715
Dec. 3- 9.....	269	167	177	534	373	705
Dec. 10-16.....	281	177	149	461	383	780
Dec. 17-23.....	253	225	219	407	376	849
Dec. 24-30.....	331	243	204	474	376	853
Dec. 31-Jan. 6	237	159	169	363	394	619
Jan. 7-13.....	271	194	178	426	377	699

It will be observed that in one week, December 24–30, the number of births in Berlin was only 45 in excess of the number in Amsterdam, although the population is only 80,000 short of three times the size of that of Amsterdam.

Two other large German cities are included in the comparative statistics of the Amsterdam Bureau. They are Leipzig and Dresden. Leipzig has a population of 676,289, or 50,000 more than the population of Amsterdam. In the week ended November 5–11 the births in Leipzig were 108, compared with 255 in Am-

sterdam. In no week did the births in Leipzig approach within 100 those in Amsterdam. Dresden, with a population of 579,536, compared with Amsterdam's 626,470, had in the first of the weeks mentioned 118 births compared with 255 in Amsterdam, the deaths in that week being exactly the same—namely, 126. The highest number of births in Dresden in the weeks mentioned was 142 and the lowest number of deaths 103, while the highest number of deaths was 198.

ANCIENT DWELLINGS IN NAVAHO NATIONAL MONUMENT, ARIZONA

Mr. Neil M. Judd, of the United States National Museum, has left for Arizona to supervise for the Smithsonian Institution the excavation and repair of prehistoric ruins and cliff dwellings. The work will be carried on under a provision in the Indian Appropriation Act, Interior Department, for the preservation and repair of the remains of ancient dwelling places of certain American aborigines in the Navaho National Monument.

According to a bulletin of the Smithsonian Institution the Navaho National Monument comprises three large ruins located in the northern part of the Navaho Reservation, in Arizona, about 175 miles by trail north of Flagstaff. There is a road for about a third of the way, but there is little traffic from its termination to the Navaho Monument. From there the way is difficult to travel also on account of the scarcity of water in the desert to be crossed, the lack of opportunity to purchase supplies, and the steepness of the ascent near the monument which is truly in the "High Rocks," as the Hopi designate the location of their former home.

The trip requires about five days, but the route is an interesting one, for it passes through Painted Desert, a picturesque country especially attractive on account of the native legends and descriptions relating to the surroundings. Superstition Mountain, for example, where, so the Navaho stories relate, fires are to be seen on dark nights, recalls the old Snake legend which claims that all this country once belonged to the Fire God, and that they inherited it from him. In the olden days, so they relate, the inhabitants used to see lights moving around the mesas. Journeying over the recent lava beds and cinder plains to-day, it is easy for the traveller to accept the story of the early proprietorship of this burnt-out country, and attribute the fires seen there to volcanic eruptions and the glowing lava of years ago, which is quite enough to substantiate the legend. Among the fantastically eroded rocks, forming natural sculptures along the trail, are Elephant Legs, and White Mesa Natural Bridge, which lend interest en route to the Monument, as does also the Indian Village where still dwell descendants of the early inhabitants.

The ancient pueblo and cliff dwellings were first scientifically examined in 1908, by a party of which Mr. Judd was a member, led by Professor Byron Cummings, formerly of the University of Utah and now of the University of Arizona. They are supposed to be the ruins of dwellings made by the Snake people whose descendants live to-day in Hopi villages in northeastern Arizona. Some of the houses built in the cliffs are very large, measuring several hundred feet in length and include as many as a hundred rooms. Naturally, some of the original rooms are buried in fallen debris but their excavation and repair is to be carried out between now and the end of June, by Mr. Judd and his party.

The only human beings living in the neighborhood of these ruins is an Indian trader, and a few Navahos who are very superstitious. None of them will dig in the ruins fearing to evoke the wrath of the spirits of the dead, so Mr. Judd will be forced to engage white laborers at Flagstaff, probably six in number and a cook, relying on the native Navahos only for trail-making and the transportation of his supplies and building materials to the ruin where the work is to be done.

THE INDIAN SCIENCE CONGRESS

From an account in *The Englishman,* Calcutta, we learn that the fourth annual meeting of the Indian Science Congress opened on January 10 in Bangalore. A large and distinguished gathering of scientific men from

all parts of India is said to have been present, including the Hon. Mr. H. V. Cobb, Sir Alfred Bourne, Sir Sidney Burrard, Mr. J. Mackenna, Dr. Mackighan, Dr. J. L. Simmonson, Dr. H. E. Watson, Mr. R. H. Campbell, C.I.E., Dr. Harold Mann, Dr. T. M. Nair, Dr. E. H. Hankin. There were also a number of prominent local officials and others present.

The Maharaja of Mysore in opening the congress welcomed the members and made a short speech in the course of which he referred to the war. He said that one could not help feeling it a tragedy that science, to which the world so largely owed its progress and civilization, was being, as it were, debased in this war and used for the purpose of destroying human life. But may we not hope that good may come out of evil and that the lesson which the present war will leave behind of the appalling results of applying discoveries of science to the fast destruction of the human race, may eventually bring about a world peace by making the very thought of war abhorrent? May we not look forward to the time when science will be hailed not only as a beacon light of civilization but as the world's peacemaker? He alluded to the effect on Indian conditions of efforts made in the British Isles to develop science and trade and promote economic efficiency and said that the recent appointment of the industries commission will also doubtless help in that direction. He thought that some organization on the lines of the advisory board recently brought into existence in England, should be attempted in India, and referred to the need of further expansion of the Indian Institute of Science on its practical side.

As president of the Chemistry Section, Dr. J. L. Simonsen, of the Presidency College, Madras, said in the course of his address to that body:

> I do not think that we can say that all is well with chemistry in India. I would submit for your consideration what I consider to be the four main causes of the paucity of research: (1) That in many colleges the staff are insufficiently trained. I do not intend to throw any aspersions on a hard working and worthy body of men; it was not their fault that when at college they received a training which did not fit them for higher teaching or research and for reasons which I shall mention they have had no subsequent opportunity to improve their knowledge. (2) That the majority of colleges are very much understaffed. This, in my opinion, is the most serious defect and the main cause of the present state of affairs. (3) The low rate of pay in academic posts. (4) The present method of promotion by seniority and not by merit. Of the other causes to which lack of research has from time to time been ascribed, I may perhaps mention two, namely, the want of library facilities and the want of a scientific atmosphere. I can not bring myself to believe that these are really serious factors. It is always a somewhat delicate matter to discuss the question of the pay offered in the various collegiate appointments. It appears to me, however, that unless the scale of pay is improved it will be impossible for us to attract the best intellects. The tendency for teaching and research to deteriorate is further announced by the fact that in practically all cases promotion is made by seniority and not by merit. I am quite willing to admit that in the larger services, such as the various government educational services, it will be a matter of considerable difficulty to make any change in the system, but I really can not imagine that it is beyond the wit of man to devise some more satisfactory scheme than the present one. One can but too well understand the feelings of a brilliant young investigator when he sees a colleague promoted to a higher post who has done nothing to render himself worthy of it, beyond putting in a certain number of years of service. This system must be radically altered if we are to see research really develop.
>
> I have dealt with the question of the staffs of the colleges at some length because I feel it to be of vital importance. We have to meet in this country the same opposition as has to be met in England. The heads of colleges, the managers of schools, in short, the authorities in charge of education, have, as a rule, little or no appreciation of the importance of science or of its requirements. It is, perhaps, too late in the day for us to educate them, but we must make sure that the rising generation is not similarly steeped in ignorance. We must insist that our science shall be given a fair chance and that our schools shall not be sweated. I use this strong word with intent, but that they shall be given an opportunity for original work, for I very strongly hold the view that no man can remain a first-class teacher or inspire his students who

is not actively engaged in research. The future is in our hands, let us prove ourselves worthy.

THE GORDON McKAY ENDOWMENT FOR APPLIED SCIENCE

In the *Harvard Alumni Bulletin* the situation in regard to the McKay bequest is reviewed. It was a little more than three years ago that the agreement of cooperation between Harvard University and the Massachusetts Institute of Technology for instruction in the field of the engineering sciences was announced. The funds for putting these plans into effect are drawn from the great bequest of Gordon McKay to Harvard University, made for the purpose of establishing a school of applied science. This fund is held by trustees who, under the terms of Mr. McKay's will, have already transferred about two million dollars to the university and are expected, on the death of all the annuitants provided for, to bring the total payments to $22,000,000. The cooperative arrangement between Tech and Harvard was no sooner made known than the McKay trustees, of whom the late James J. Myers, '69, was one, objected to it on the ground that it would not fulfil the wishes of Gordon McKay, who might have bequeathed his fortune to Technology, but deliberately committed it to Harvard instead. Accordingly the plan of cooperation has been put only into provisional practise in the new buildings of Technology. To ascertain whether the arrangement could be made permanent, the Harvard authorities, after introducing certain changes into the agreement, designed to meet some of the objections of the McKay trustees, petitioned the Supreme Court of Massachusetts to pass upon the legality of the arrangement.

The case has now come before Judge Pierce of that court for a hearing to determine the facts on which the court's interpretation of the law must be based. Charles F. Choate and Mr. John G. Milburn, of New York, appeared as chief counsel, respectively, for Harvard University and the McKay trustees. There was much reading of documents. President Eliot, President Lowell, President Maclaurin of the Institute, and Mr. Frank F. Stanley, one of the trustees, appeared as witnesses. The testimony presented bore upon the history of the negotiations between Harvard and Tech, and of instruction in applied science at Harvard; also upon the method and extent of the control secured to Harvard, under the agreement, in the expenditure of the McKay bequest. The hearing lasted three days. In due time the case will go to the full bench for argument.

The provisions of Mr. McKay's will include the following:

> The net income of said endowment shall be used to promote applied science:
>
> *First.* By maintaining professorships, workshops, laboratories and collections for any or all of those scientific subjects, which have, or may hereafter have, applications useful to man, and
>
> *Second.* By aiding meritorious and needy students in pursuing those subjects.
>
> Inasmuch as a large part of my life has been devoted to the study and invention of machinery, I instruct the president and fellows to take special care that the great subject of mechanical engineering in all its branches and in the most comprehensive sense, be thoroughly provided for from my endowment.
>
> I direct that the president and fellows be free to provide from the endowment all grades of instruction in applied science, from the lowest to the highest, and that the instruction provided be kept accessible to pupils who have had no other opportunities of previous education than those which the free public schools afford.
>
> I direct that the salaries attached to the professorships maintained from the endowment be kept liberal, generation after generation, according to the standards of each successive generation, to the end that these professorships may always be attractive to able men and that their effect may be to raise, in some judicious measure, the general scale of compensation for the teachers of the university.
>
> I direct that the professors supported from this endowment be provided with suitable assistance in their several departments, by the appointment of instructors of lower grades, and of draughtsmen, foremen, mechanics, clerks or assistants, as occasion may require, my desire being that the professors be free to devote themselves to whatever part of the teaching requires the greatest skill and largest experience, and to the advancement of their several subjects.
>
> I direct that the president and fellows be free to

erect buildings for the purposes of this endowment, and to purchase sites for the same, but only from the income of the endowment.

I direct that all the equipment required to illustrate teaching or to give students opportunity to practise, whether instruments, diagrams, tools, machines or apparatus, be always kept of the best design and quality, so that no antiquated superseded, or unserviceable implement or machinery shall ever be retained in the lecture rooms, workshops or laboratories maintained from the endowment.

SCIENTIFIC NOTES AND NEWS

DR. ALEXANDER GRAHAM BELL, inventor of the telephone, was awarded the Civic Forum Gold Medal for distinguished public service in New York on March 21. The presentation address was made by Dr. John H. Finley, state commissioner of education. Dr. Bell is the third recipient of the medal. It was awarded to Major General George W. Goethals in 1914, and to Thomas A. Edison in 1915.

E. W. RICE, JR., of Schenectady, N. Y., has been nominated by the board of directors of the American Institute of Electrical Engineers as president for the coming year.

DR. CHARLES D. WALCOTT, secretary of the Smithsonian Institution, has been elected chairman, and Dr. S. W. Stratton, of the Bureau of Standards, secretary of the military committee of the National Research Council.

A RESEARCH committee to cooperate with the National Research Council has been appointed by President W. H. P. Faunce, of Brown University. The committee includes from the faculty Carl Barus, physics, Albert D. Mead, biology, Roland G. D. Richardson, mathematics, and John E. Bucher, chemistry; from the university corporation Chancellor Arnold B. Chace and Edwin Farnham Greene, treasurer of the Pacific Mills; from the alumni J. B. F. Herreshoff, of the Nichols Chemical Company, Charles V. Chapin, of the Providence board of health, John C. Hebden, of the Federal Dyestuffs Corporation and Frank E. Winsor.

PROFESSOR VON GRÜTZNER has resigned as director of the Physiological Institute, Berlin, because of advanced age.

DR. RALPH E. HALL, assistant professor of inorganic chemistry at the Iowa State College, has resigned to accept a position in the geophysical laboratory of the Carnegie Institution, Washington, D. C.

ABOUT a year ago Professor M. A. Rosanoff, of the Mellon Institute, University of Pittsburgh, and Professor W. D. Harkins, of the University of Chicago, exchanged one week's service, Dr. Rosanoff lecturing on chemical kinetics at Chicago and Dr. Harkins lecturing on the periodic law at Pittsburgh. This spring the exchange will be repeated, but extended in time to six weeks. Dr. Rosanoff has been invited to deliver at Chicago a full university course of lectures on stereo-chemistry and a briefer one on his theory of chemical reactions. At the same time, namely, from early in April to about May 12, Dr. Harkins will give a full graduate course of lectures on thermo-chemistry at the Mellon Institute and the graduate school, University of Pittsburgh.

HARRISON W. CARVER, who has been connected with the Carnegie Library of Pittsburgh for seventeen years and has been chief librarian there since 1908, has been appointed director of the library of the American Engineering Societies in New York City. Mr. Carver has tendered his resignation in Pittsburgh and is expected to begin his new work in April.

A THIRD relief expedition will be sent to the Arctic this summer by the American Museum of Natural History to bring home the members of the Crocker Land expedition, which went north in 1913. The latest word of the expedition came from Dr. Hovey in a letter dated July 10, 1916, and was brought out by the *Cluette* last September. At that time all were well. The second relief ship, the *Danmark,* was reported in Melville Bay, 150 miles southeast of Capt York, on August 20, 1916. Admiral Peary and others think she probably reached North Star Bay at least and that the explorers are on board. The third vessel will be sent to Etah, leaving St. John's early in July. The committee hopes to obtain a Newfoundland sealer for this purpose and to bring

the Crocker Land expedition back to Newfoundland late in August.

Dr. Simon Flexner, of the Rockefeller Institute, lectured at Wellesley College, on March 9, on "The Physical Basis of Immunity."

The Cutter lecture on preventive medicine and hygiene will be given by Dr. Ludwig Hektoen, director of the Memorial Institute for Infectious Diseases, Chicago, on April 3, at the Harvard Medical School. Dr. Hektoen will discuss "Poliomyelitis in the Light of Recent Observations."

Professor H. S. Jennings, of the Johns Hopkins University, is delivering a series of four Westbrook lectures on Heredity and Evolution at the Wagner Institute, Philadelphia.

Graduate seminars will be offered in the coming summer session of the University of California by Professor E. C. Franklin on "Non-Aqueous Solutions" and by Professor J. H. Hildebrand on "The Theory of Solubility."

On March 8 Dr. Haven Metcalf, of the Bureau of Plant Industry, delivered an address before the department of plant pathology of the University of Wisconsin on "The White Pine Blister Rust: An Example of the Imported Plant Disease."

Professor Frederick C. Ferry, dean of Williams College, gave, on March 1, an address on "Present Problems of Mathematics Teachers in Secondary Schools," before the Mathematics Club of Vassar College.

James Alton James, chairman of the board of graduate studies and professor of history at Northwestern University, delivered an illustrated lecture on "The Conservation of Historic Sites in Illinois" at a meeting of the Society of the Friends of our Native Landscape on the evening of March 20, at Fullerton Hall, Art Institute, Chicago.

Professor Robert F. Griggs, of the Ohio State University, lectured on March 17 before the University Club of Chicago on "The Valley of the Ten Thousand Smokes."

The fifth annual conference of the American Association of Agricultural Editors will be held at Cornell University on Thursday and Friday, June 28 and 29. This association is made up of the editors of the agricultural colleges and experiment stations, and meets annually to exchange ideas. Among the institutions represented are the state universities of Ohio, Wisconsin, Illinois, West Virginia, Kentucky, Tennessee, Missouri, North Dakota, South Dakota, Mississippi and Minnesota; the state agricultural colleges of Iowa, Massachusetts, Maryland, Michigan, Georgia, Oklahoma and Kansas; Clemson College and Purdue and Cornell universities.

During the year 1916–17 the graduate courses in chemistry at the Johns Hopkins University have included a series of lectures on selected topics by chemists from other institutions. The subjects chosen have been generally of a physical-chemical nature. Those who have thus far participated in these lectures are: Professor Gilbert N. Lewis, of the University of California, who gave three lectures on the subject of free energy; Professor Harry N. Holmes, of Oberlin College, whose subject was the formation of crystals in gels; Dr. Irving Langmuir, of the General Electric Company, the structure of liquids and solids; Dr. Walter A. Patrick, of Syracuse University, who gave five lectures on colloidal chemistry.

The Morison lectures before the Royal College of Physicians of Edinburgh were delivered on March 5 and 9 by Dr. Edwin Bramwell, the subject being The Neurology of the War. The first lecture dealt with gunshot wounds of the peripheral nerves, and the second with shell shock and some effects of head injuries.

The Huxley lecture at the University of Birmingham is to be delivered by Professor D'Arcy W. Thompson, whose subject is "Shells."

The death is announced at seventy-four years of age of Professor J. G. Darboux, permanent secretary of the Paris Academy of Sciences and professor of mathematics at the Sorbonne.

R. H. Tiddeman, from 1864 to 1902 geologist of the British Geological Survey, died on February 11, at the age of seventy-five years.

GEORGE MASSEE, for many years head of the cryptogamic department of the Herbarium of the Kew Gardens, distinguished for his work in mycology, died on February 17, at the age of sixty-seven years.

M. JULES COURMONT, professor of hygiene at Lyons, died on February 24.

W. H. H. JESSOP, a well-known English ophthalmic surgeon, died on February 16, at the age of sixty-four years.

THE death is announced of G. Paladino, professor of histology and general physiology at the University of Naples, senator of the realm, president of various scientific societies and member of numerous others in various countries, aged seventy-five years.

IT is planned to dedicate the completed laboratory building and plant houses of the Brooklyn Botanic Garden on April 19–21. There will be formal exercises, followed by a reception, on Thursday evening, April 19. Sessions for the reading of scientific papers will be held on Friday morning and afternoon, and on Saturday morning. On Friday evening there will be a popular scientific program in the lecture hall, and on Saturday afternoon a conference for teachers to consider how the Botanic Garden may become most useful to the public and private schools of the city. The public is cordially invited to the sessions on Friday and on Saturday morning.

PROFESSOR R. TRIPIER, formerly of the University of Lyons, has bequeathed to the university the sum of $40,000, the income of which is to be used to encourage works on operative medicine and pathologic anatomy. He also left a similar sum to the city of Lyons for the purchase every fifth year of some work of art.

A BILL has been introduced in the Minnesota legislature requiring the board of regents to terminate the arrangement between the University of Minnesota and the Mayo foundation.

ACCORDING to the *British Medical Journal* the city of Paris has adopted the policy of erecting in the garden of its hospitals huts for men discharged from the army suffering from tuberculosis. Some 660 beds have already been provided in this way, and huts for 1,500 more are being put up as fast as the scarcity of labor permits. A sum of £200,000 has been voted for construction, and the expense of maintenance is estimated at £120,000 a year.

THE German Congress of Internal Medicine will be held in April, 1917, under the chairmanship of Professor Minkowski. The most important subjects for discussion will be: (1) Nutrition during the war, by M. Rubner (Berlin) and F. von Müller (Munich), (2) Constitutional diseases, by F. Kraus (Berlin) and A. Steyrer (Innsbruck), (3) The rare infectious diseases of the war. War experiences in the field of internal medicine will also be discussed.

SEVERAL research fellowships in the department of preventive medicine and hygiene at Harvard University are available for the scientific investigation of food poisoning. The work may at the same time be credited towards the doctor of public health degree. Candidates should apply to Dr. M. J. Rosenau, Harvard Medical School, Boston, Mass.

LAST year Dr. Charles McIntire resigned the secretaryship of the American Academy of Medicine after twenty-five years of service. In appreciative commemoration the American Academy of Medicine decided to raise a fund, the income of which should be expended in accordance with Dr. McIntire's suggestions. As a consequence the academy now announces two prize offers, the prizes to be awarded at the annual meetings for 1918 and 1921, respectively. The subject for 1918 is "The Principles Governing the Physician's Compensation in the Various Forms of Social Insurance." The members of the committee to decide the relative value of the essays awarding this prize are: Dr. John L. Heffron, dean of the College of Medicine, Syracuse University; Dr. Reuben Peterson, professor of obstetrics and diseases of women, University of Michigan, and Dr. John Staige Davis, professor of pediatrics and practise of medicine, University of Virginia. The subject for 1921 is "What Effect Has Child Labor on the Growth of the Body?" The members of the committee to award this prize are: Dr. Thomas S. Arbuthnot, dean of

the medical school of the University of Pittsburgh; Dr. Winfield Scott Hall, professor of physiology, Northwestern University, and Dr. James C. Wilson, emeritus professor of the practise of medicine and of clinical medicine, Jefferson Medical College.

UNIVERSITY AND EDUCATIONAL NEWS

"Gilman Hall" has been decided upon as the name of the first unit, now being built at a cost of $220,000, of the future group of permanent buildings for chemistry at the University of California. This name was chosen by the regents in honor of Daniel Coit Gilman, president of the University of California from 1872 to 1875, to whose initiative was due the organization of the college of chemistry of the university, and who in his later career as president of Johns Hopkins University did such notable service to the development of opportunities in the American universities for training for scientific research.

Goucher College has announced the completion of a "Supplemental Endowment Fund" of $1,000,000, one fourth of which was conditionally subscribed by the General Education Board. Nearly half of the entire amount has already been paid in.

A bill introduced into the Illinois legislature proposes expenditures for the medical department of the University of Illinois amounting to $2,000,000 during the next decade.

Mrs. Alexander F. Morrison, formerly president of the National Association of Collegiate Alumnæ, has given $1,500 to the University of California for the purchase of an ophthalmological library of 486 volumes for the University of California medical school.

Mrs. Roscoe R. Bell, of Brooklyn, has given the valuable library on comparative and veterinary medicine belonging to the late Professor Roscoe R. Bell, to the Alexandre Liautard Library of New York University.

Dr. Ellsworth Huntington, who resigned from Yale University several years ago to devote his entire time to research work, will become officially connected with the university again next year as a research associate in geography. Dr. Huntington will make his headquarters in New Haven and will give every year a course of lectures on his investigations, which cover a broad field that has to do particularly with the effect of climatic changes on the course of civilization.

There has been appointed at the Massachusetts Institute of Technology a committee of the faculty to consider ways of improving the methods of instruction and Dr. Charles R. Mann has been called to the institute to be chairman of the committee. Dr. Mann is professor of physics in the University of Chicago, but for the past two years has been on leave of absence to make a report on engineering education under the auspices of the Carnegie Foundation for the Advancement of Teaching.

DISCUSSION AND CORRESPONDENCE

MORE "MOTTLE-LEAF" DISCUSSION

In a recent paper Briggs, Jensen and McLane[1] discuss the situation with regard to "mottle-leaf" in citrus trees based on certain observations which they have made on orchards located in southern California. The undersigned has read their statement with the greatest interest and desires in the friendly spirit of a scientific colleague to make some comments thereon by way of broadening the discussion.

1. In reviewing the causes which have been given in the past for the production of "mottle-leaf" conditions, the authors above named mention the theories of Smith and Smith[2] and of Thomas[3] but say nothing of that promulgated in 1914 by the undersigned[4] which still seems to me to be the most definite and reasonable hypothesis for explaining the conditions in question in citrus trees.

2. Briggs, Jensen and McLane have pointed out that about half of the "mottling" is associated with soil conditions in which humus is

[1] *Jour. Agr. Res.*, Vol. 6, No. 19, p. 721, August, 1916.

[2] *Calif. Agr. Expt. Sta. Bull.*, No. 218, pp. 1139–1911.

[3] *Calif. Agr. Expt. Sta. Circ.*, 85, 1913.

[4] Science, N. S., Vol. 39, No. 1011, p. 728, May, 1914.

deficient, but this, it seems to me, gives no justification for the following statement, which I quote from their paper:

> An impartial statistical study of the data from the individual orange groves shows that approximately one half the mottling *can be accounted*[5] *for* by the low humus content of the soil.

3. That all or nearly all citrus soils in southern California are deficient in organic matter has long been known. But to state that half of the mottling "can be accounted for" by deficiencies of the soil in humus when the other half of the mottling is not at all accounted for seems to me to be an unusual procedure.

4. Moreover, the method employed by Briggs, Jensen and McLane for determining humus, upon which much of their discussion depends, has already been pointed out by Gortner[6] to be insecure if not entirely inaccurate. In the writer's laboratory it has also been found that intensity of color is no criterion of the amount of humus. Moreover, no one has yet proved, and there is no justification for believing that the humus portion of the soil organic matter, as determined by any of the arbitrary methods in vogue, is of any greater value to plants or to soils than the rest of the soil organic matter.

5. That as the paper under discussion points out the total nitrogen content of soils is not related to the amount of mottling should be no cause for surprise since it is the amount of "available" nitrogen as the writer has on many occasions pointed out rather than the amount of total nitrogen that should reasonably be assumed to affect plant growth. This is especially true under arid soil conditions, in which, moreover, the term "available" possesses more than the usual significance.

6. It seems to the writer that we need a theory or theories on some definite and specific cause of "mottle-leaf" in citrus trees and not a description of some general condition like a deficiency of organic matter which can affect soils in many different ways, not always in the same direction, and which besides is universally recognized to constitute the most undesirable feature of arid soils.

7. As Briggs, Jensen and McLane point out, however, something which affects chlorophyll formation in the leaves of the citrus tree is responsible for the trouble. That factor, in my opinion, is a lack of usable nitrogen, and in view of the peculiar mineral conditions of our soils, it may in many instances also be due to a lack of usable iron.

8. The writer does not wish to be understood as denying the effectiveness of a lack or of a sufficiency of organic matter in the production or eradication, respectively, of mottle-leaf in citrus trees. He does desire, however, to deny that there is anything specific about the organic matter factor, since it can affect plants in one of so many different ways; that the portion of the soil organic matter known as humus is any criterion as to the activity and value of the soil organic matter; that the "mottling of orange trees has been definitely correlated with the low humus content of the soil per se; and that soluble organic matter placed in the zone of the feeding roots promises any better for the eradication of "mottle-leaf" than the practise of green manuring which, to put it mildly, has thus far fallen far short of the expectations originally entertained for it.

9. As I have pointed out in the papers above cited, we shall probably be compelled not only to supply sufficient available nitrogen to eradicate the physiological troubles of our citrus and other crops, but we shall have to make it usable by some method of soil protection which will make it possible for roots of plants to make use of the surface soil. The most promising method of soil protection now seems to be complete straw mulching.

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[5] Italics mine.

[6] "Soil Science," Vol. 2, No. 5, p. 395, November, 1916.

LORD LISTER ON THE VALUE OF VIVISECTION

TO THE EDITOR OF SCIENCE: The enclosed rough draft of a letter to "Dr. Keen" (as the envelope was endorsed) was found among the late Lord Lister's papers by his nephew and

biographer, Sir Richman J. Godlee and is published by his consent.

W. W. Keen

My dear Sir: I am grieved to learn that there should be even a remote chance of the Legislature of any state in the Union passing a bill for regulating experiments upon animals.

It is only comparatively recently in the world's history that the gross darkness of empiricism has given place to more and more scientific practise, and this result has been mainly due to experiments upon living animals. It was to these that Harvey was in large measure indebted for the fundamental discovery of the circulation of the blood, and the great American triumph of General Anesthesia was greatly promoted by them. Advancing knowledge has shown more and more that the bodies of the lower animals are essentially similar to our own in their intimate structure and functions; so that lessons learnt from them may be applied to human pathology and treatment. If we neglect to avail ourselves of this means of acquiring increased acquaintance with the working of that marvelously complex machine, the animal body, we must either be content to remain at an absolute standstill or return to the fearful haphazard ways of testing new remedies upon human patients in the first instance which prevailed in the dark ages.

Never was there a time when the advantages that may accrue to man from investigations on the lower animals were more conspicuous than now. The enormous advances that have been made in our knowledge of the nature and treatment of disease of late years have been essentially due to work of this kind.

The importance of such investigations was fully recognized by the commissioners on whose report the act of Parliament regulating experiments on animals in this country was passed, their object in recommending legislation being only to prevent possible abuse.

In reality, as one of the commissioners, the late Mr. Erichsen, informed me, no single instance of such abuse having occurred in the British Islands had been brought before them at the time when I gave my evidence and that was toward the close of their sittings.

Yet in obedience to a popular outcry, the government of the day passed an act which went much further than the recommendation of the commissioners. They had advised that the operation of the law should be restricted to experiments upon warm-blooded animals; but when this bill was considered in the House of Commons, a member who was greatly respected as a politician, but entirely ignorant of the subject matter, suggested that "Vertebrate" should be substituted for "warm blooded" and this amendment was accepted by a majority as ignorant as himself.

The result is that, incredible as it may seem, any one would now be liable to criminal prosecution in this country who should observe the circulation of the blood in a frog's foot under the microscope without having obtained a license for the experiment and unless he performed it in a specially licensed place.

It can readily be understood that such restrictions must seriously interfere with legitimate researches.

Indeed for the private practitioner they are almost prohibitive; and no one can tell how much valuable work is thus prevented.

My own first investigations of any importance were a study of the process of inflammation in the transparent web of the frog's foot. The experiments were very numerous, and were performed at all hours of the day at my own house. I was then a young unknown practitioner; and if the present law had been in existence it might have been difficult for me to obtain the requisite licenses; even if I had got them it would have been impossible for me to have gone to a public laboratory to work. Yet without these early researches which the existing law would have prevented I could not have found my way among the perplexing difficulties which beset me in developing the antiseptic system of treatment in surgery.

In the course of my antiseptic work, at a later period, I frequently had recourse to experiments on animals. One of these occurs to me which yielded particularly valuable results, but which I certainly should not have done if the present law had been in force. It had reference to the behavior of a thread composed of animal tissue applied antiseptically for tying an arterial trunk. I had prepared a ligature of such material at a house where I was spending a few days at a distance from home, and it occurred to me to test it upon the carotid artery of a calf. Acting on the spur of the moment, I procured the needful animal at a neighboring market; a lay friend gave chloroform, and another assisted at the operation. Four weeks later the calf was killed and its neck was sent to me. On my dissecting it, the beautiful truth was revealed that the dead material of the thread, instead of being thrown off by suppuration, had been replaced under the new aseptic conditions by a firm

ring of living fibrous tissue, the old dangers of such an operation being completely obviated.

I have referred thus to my personal experience because asked to do so, and these examples are perhaps sufficient to illustrate the impediments which the existing law places in the way of research by medical men engaged in practise, whose ideas, if developed, would often be the most fruitful in beneficent results.

But even those who are specialists in physiology or pathology, and have already access to research work seriously hampered by the necessity of applying for licenses for all investigations, and the difficulty and delay often encountered in obtaining them.

Our law on this subject should never have been passed, and ought to be repealed. It serves no good purpose, and interferes seriously with inquiries which are of paramount importance to mankind. Believe me, sincerely yours. LISTER

QUOTATIONS

SCIENCE AND THE GERMAN CIVIL SERVICE[1]

THE committee of the Institution of German Engineers urges that steps should be taken by modification of the law in the Confederated States, and particularly in Prussia, by removing the obstructions of the law of 1906 concerning eligibility for the higher posts in the civil service so as to make it possible that not only lawyers, but also graduates of the technical high schools should be able to take up careers in the higher civil service.

Already before the war, after exhaustive discussions extending over many years, the demand had been expressed that candidates for the higher posts in the civil service should be given a scientific academic training, so as to enable them to have a full understanding of the conditions of public life upon which industrial questions and the requirements of trade and commerce exert a preponderating influence at the present day. The war has confronted the state with an unexpected number of new problems that have caused it to call into its service the intellect of the most diverse professions. This extension of admission to the higher careers in the civil service that has been introduced under the pressure of the circumstances of the time must be extended, the barriers that still exist in this respect must be removed, if it is to be possible to ensure the full development of the economic forces of the country after the war. It has now become an imperative necessity that the demand that has been expressed for many years by the Institution of German Engineers should be fulfilled, and that university graduates, particularly of the technical high schools, should be admitted to the higher grades of the civil service, so as to place the selection for this career on a broader basis.

Already ten years ago, on the occasion of the discussions in the Prussian Diet on the government proposals concerning the change of the course of study for law (1903), and later, after their rejection, in the discussions on the law concerning eligibility for careers in the higher civil service (1906), the government admitted readily that the training of the higher civil service officials did not correspond with the requirements of the day. The removal of this defect was unsuccessfully attempted at that time by a proposed reform of the academic curriculum, and is supposed now to have been achieved by means of the law of 1906 by measures that only take effect subsequent to the academic study. Later experience has shown that the method that has been adopted is hardly likely to be able to impart to the coming generation of state officials a special understanding of the economic processes that govern life in our days. The training of the majority of higher-grade officials in the civil service and communal bodies that has become customary and has been determined by the law consists in a secondary school education that has a particular bias towards the humanities, and a short university course which is almost exclusively composed of legal subjects.

The course of study laid down for the lawyers is at the same time, and without change, also the course of study for the officials of the civil service. This rigid connection of profes-

[1] Translation in the London *Times* Educational Supplement of a letter in favor of the opening of the German civil service to men of scientific training which has been addressed to Herr von Bethmann Hollweg by the Institution of German Engineers.

sions, that must be admitted to be very different in their practise, is unique in the whole educational system of Germany. It constitutes an inherent contradiction, and has gradually become an unsurmountable obstacle which will in all probability wreck the system that was to be built on the foundation of the law of 1906. The system of training that has been described above has created the peculiar situation that all young people who have a leaning towards any one of the numerous branches of the civil service, whether by family tradition, ideals, or special capacity, are forced, even against their inclination for science, to devote themselves completely to a legal training in order to pass the first law examination, as this provides practically the first documentary evidence obtainable for admission to a civil service career in the empire, the states, the communities, and many other posts. This route is closed to the graduates of other faculties—for instance, of all the experimental sciences—by the provisions of the above-mentioned Prussian law and of similar laws in the other German states, as well as by the custom that is developing in consequence of this law of appointing lawyers for administrative work.

In consequence of the preponderating influence that technical questions and the requirements of industry have to-day on all branches of public life and the increasing participation of the provinces, communities and towns in technical and scientific enterprises, civil servants are called upon to deal with problems the expert solution of which calls for just the type of mental equipment that is provided by the technical high schools. The greater part of the education at these institutes is not based on retrospection and definition, but is directed forwards and designed with a view to productive activity. An education among such surroundings must give at least as good a training for a civil service career as an education the principal aim of which is to classify the particular requirements of life according to legal conceptions. The knowledge of law and administration that is required by civil servants can be acquired to-day in every technical high school.

SCIENTIFIC BOOKS

The Measurement of Intelligence. By Lewis M. Terman. Houghton, Mifflin Co., New York. 1916. Pp. 362.

In the past few years the practise of what is termed "clinical psychology" has tended to outrun itself, in the sense that measurements of intellect have been demanded in all quarters, while methods were still tentative. Binet conceived the idea of measuring mental development by age levels, but he died before he could perfect his work. Binet's tests were not valid above the twelve-year level of intelligence. The tests which he offered above this level were almost universally discarded by clinical workers, as failing in their purpose. Another difficulty with the original scale lay in the fact that directions for giving the tests were not standardized. Inasmuch as the directions in giving a test constitute a very important part of the test itself, this seriously impaired the scientific value of the results obtained in testing. Moreover, in the original system no means was provided for comparing the intellectual quality of a young child with that of an older child. Obviously, for example, a retardation of one year in a child three years of age has a different meaning for diagnosis and prognosis than has a retardation of one year in a child twelve years of age. Stern had suggested the use of a relative measure of mentality, *i. e.*, the quotient obtained by dividing "mental age" by actual age, but this method never came into general use in America in connection with the original system. It is true, also, as Thorndike, Brigham and others have shown, that there were discrepancies between certain of the age levels as determined by Binet, and the "true" age levels. These discrepancies were due, no doubt, to the fact that Binet had not been able to standardize his tests on a sufficient number of subjects.

Goddard, Kuhlmann and other American elaborators of Binet did not advance much beyond the first work in these particulars. More recently Yerkes, Bridges and Hardwick in their point scale have eliminated many of the original crudities, and in their mental co-

efficient have proposed a relative measure of intelligence.

The present volume embodies the results of long and patient labor in overcoming and correcting the imperfections in the original Binet-Simon scale. Standardized tests are provided through average adult and superior adult levels, making the scale valid for the detection of "borderline cases." Standardized directions (admirably simple and natural) are given for every test. The method of scoring has been refined, so that the individual's mental status is determined by months, and the Intelligence Quotient becomes the measure of ability. This is obtained by dividing the "mental age" by the actual age. One would predict that this Intelligence Quotient (I. Q.) will be made the subject of much discussion and investigation during the next few years.

Six tests are provided for each year up through ten years, instead of four or five, as in the Goddard Revision, which has been most widely used in this country. The Stanford Revision, as the author modestly chooses to designate his work, is by no means a mere rearrangement of the old, familiar tests. The new scale is rich in original contributions, such as the vocabulary test, and the ball-in-the-field test. For these many cleverly conceived tests Terman gives much credit to his collaborators.

The time devoted to an examination according to the Stanford Revision is considerably greater than in the case of the former revisions. This will be a good thing from the point of view of everybody except administrative officers. The number of psychological examinations now expected daily of psychologists working in various public capacities, is little short of a scientific scandal.

The wide usefulness into which this volume has already come testifies to its timeliness as a treatise on the subject. The book is so written and so organized that it serves almost equally well as a text, as a manual, or as a reference. The first half is taken up with a discussion of the technique and method of measuring intelligence, and with the history of graded tests. The subject is clearly and simply presented in non-technical terms. The second half is given over to a presentation of the revised tests themselves, with the directions for giving and the method of scoring each. The necessary test material may be purchased from the publishers of the book.

It would seem inevitable that the Stanford Scale will, in general, replace all revisions of the Binet-Simon Measuring Scale for Intelligence hitherto in use in clinics and in institutions, because it is more scientific and more complete than any other which has been made available. The method of scoring by years and months of "mental age," however, may and probably will prevent its adoption by those psychologists who believe that the method of scoring by "points" is preferable.

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Telegraphy. By T. E. HERBERT. London and New York, Whittaker and Co. Third Edition. 985 pages, 630 illustrations. Cloth, nine shillings net.

This is the third and a thoroughly revised edition of an excellent handbook on British telegraphy, designed to meet the needs of the technical student and the requirements of departmental technical examinations of the staff.

The mathematics employed are quite elementary, so that no difficulties need be apprehended by the technical student in this direction. The telegraphic apparatus and plant of the British post-office system are well described and explained. A strong feature of recommendation for the book is that it enters at some length into the technique of the apparatus described, and gives practical directions as to best adjustments.

The text is divided into twenty-three chapters, respectively dealing with the following topics: Introduction, Primary Cells, Circuit Calculations, Current Measurements, Battery Testing, Resistance Measurements, Single-current Systems, Condensers, Differential Duplex, Quadruplex, Wheatstone Automatic, Bridge Duplex, A B C and Recording Instruments, The Hughes, The Bandot, The Murray,

Central-Battery Systems, Secondary Cells, Secondary-Cell Working, Repeaters, Test Boxes, Telegraph Testing, Aerial Lines, Underground Lines.

As will be seen from the above list, the plan of development opens with the elementary theory of the subject, and then proceeds with detailed descriptions of the various types of apparatus in most general use. Finally, the circuits and lines are dealt with.

A number of useful appendices on special topics are inserted near the end of the book. The index of subject-matter has been prepared with great care.

As a practical telegraphist's guide, and as an elementary text-book of the principles of wire telegraphy in Great Britain, the volume deserves high praise. A. E. Kennelly

PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

The first number of Volume 3 of the *Proceedings of the National Academy of Sciences* contains the following articles:

Inferences concerning Auroras: Elihu Thomson, General Electric Company, West Lynn, Massachusetts. Auroras consist of vertical streamers which, seen from different points of perspective, give the various optical effects observed.

Application of the Laws of Action, Reaction and Interaction in Life Evolution: Henry Fairfield Osborn, American Museum of Natural History, New York City. In each organism the phenomena of life represent the action, reaction and interaction of four complexes of physico-chemical energy.

The Resistance of Metals under Pressure: P. W. Bridgman, Jefferson Physical Laboratory, Harvard University. Twenty-two metals are examined up to 12,000 kg.

The Rate of Discharge of Central Neurones: Alexander Forbes and W. C. Rappleye, laboratory of physiology, Harvard Medical School. The normal frequency of nerve impulses discharged from the ganglion cells in voluntary contraction must lie between 300 and 5,000 per second.

A Physiological Study of Noctiluca, with Special Reference to Light Production, Anesthesia and Specific Gravity: Ethel Browne Harvey, Cornell University Medical School, New York City, and department of marine biology, Carnegie Institution of Washington. These animals are able to regulate their specific gravity. Anesthetics seem to attack the mechanism of the utilization of oxygen in the absence of which light is not produced.

Physiographic Subdivision of the United States: Nevin M. Fenneman, department of geology, University of Cincinnati. The basis of division shown on the map is physiographic or morphologic. There are twenty-four major divisions, some with six to ten subdivisions.

On the Composition of the Medusa, Cassiopea Xamachana and the Changes in it after Starvation: S. Hatai, Tortugas Laboratory, Carnegie Institution of Washington.

Studies of the Magnitudes in Star Clusters, IV. On the Color of Stars in the Galactic Clouds surrounding Messier 11: Harlow Shapley, Mount Wilson Solar Observatory, Carnegie Institution of Washington. The frequency curve for colors shows great diversity of color index and general resemblance to the curve for the brighter stars in the neighborhood of the sun. A striking progression of color with decreasing brightness is shown.

The Color of the Standard Polar Stars Determined by the Method of Exposure-Ratios: Frederick H. Seares, Mount Wilson Solar Observatory, Carnegie Institution of Washington. The colors of the Polar Standards, brighter than the 13th magnitude, have been determined to about the same precision as was reached in the investigation of the magnitude scale, with an expenditure of time and labor perhaps a tenth of that in an earlier investigation.

Terracing of Bajada Belts: Charles Keyes. The feature of desert bajada-terracing, when explained upon a strictly aqueous basis, can not but lead to complete misinterpretation. It is far more largely the result of wind-action.

Relation of the Apex of Solar Motion to proper Motion and on the Cause of the Differences of its Position from Radial Velocities

and Proper Motions: C. D. Perrine, Observatorio Nacional Argentino, Córdoba.

Hydrology of the Isthmus of Panama: Brig. Gen. Henry L. Abbot, United States Army, retired. Extensive tables for rainfall, outflow, evaporation, etc., are given and discussed.

The Meteor System of Pons-Winnecke's Comet: Charles P. Olivier, Leander McCormick Observatory, University of Virginia. The elements of the meteor's orbit are determined from more than 1,000 observations.

Improvements in Calorimetric Combustion, and the Heat of Combustion of Toluene: Theodore W. Richards and Harold S. Davis, Wolcott Gibbs Memorial Laboratory, Harvard University. The improvements are: Means of effectively closing the bomb with less risk to the lining and cover; means of burning volatile liquids without loss; a method of automatically controlling the temperature of the environment; means of evaluating the incompleteness of combustion. The heat of combustion of toulene is determined as 10,155 calories (18°) per gram.

The Mass of the Electric Carrier in Copper, Silver and Aluminium: Richard C. Tolman and T. Dale Stewart. A continuation of experiments on currents produced by acceleration in metals.

The Silver Voltameter as an International Standard for the Measurement of Electric Current: E. B. Rosa and G. W. Vinal, U. S. Bureau of Standards, Washington, D. C. A summary of eight years' experimental work which has shown how the voltameter can be used as a reliable current standard and as a means of checking the constancy of the value of the Weston normal cell.

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SUGGESTIONS FOR THE DEVELOPMENT OF SCIENTIFIC LIBRARIES; WITH SPECIAL REFERENCE TO AUTHORS' SEPARATES

THE communication from Tracy I. Storer in SCIENCE for November 24, on the care of pamphlet collections, brings up a matter which has interested me for several years. It has been my task to rearrange a few scientific libraries and my privilege to consult several others, and I have found in nearly all of them considerable room for improvement, especially in the method of handling authors' separates and other pamphlets.

It seems to be a common, if not the prevailing, custom in private and semi-private scientific libraries to arrange pamphlets alphabetically by authors, as Mr. Storer recommends. This has the advantage of obviating the mental exertion of classifying them by subjects (which ought to be an important consideration with that apparently increasing class of persons who prefer to follow a mechanical routine rather than exercise judgment) and of keeping together the writings of one's friends, so that if a friend comes for a visit one can see at a glance just how many of his papers one has. But in most other respects the alphabetical arrangement is an undesirable expedient. For there is no important difference between a pamphlet and a book, and no good reason for putting a pamphlet on a different shelf from a book on the same subject (unless of course there happens to be a considerable difference in size of page or the pamphlet belongs to a series of bulletins).

Large libraries use some sort of subject classification, and this is equally desirable for small ones. When one is carrying on a particular line of research one likes to have all the literature bearing on it together as far as possible. It is out of the question to keep in mind every one who has written on a given subject, and unless a library is pretty fully catalogued (which is not usually the case with private working libraries), some pamphlets are pretty sure to be overlooked if they are not classified by subjects. Another objection to the alphabetical arrangement is that every scientist receives many pamphlets on subjects that he is not particularly interested in,[1] and with any other system than a subject classification these will always be in the way, unless they are relegated to a special "limbo."

[1] See *Torreya*, 16, 101–102, April, 1916.

Of course there will always be cases where it is difficult to decide under what head to file a pamphlet; *e. g.*, whether one on the snakes of Ireland should go with reptiles, British Isles, or mythology. But in some such cases the scale is easily turned by the owner's interests, and in others duplicates may be at hand, or obtainable on request, and can then be filed in both places. Still another plan is to make notes, on slips of paper of convenient size, or in thin note-books, of the titles of papers in serials, in other parts of the library, or in other libraries, and assemble them under their respective subjects. To provide a full series of such cross-references for a library of any size would of course be quite a task; but the references can be jotted down one at a time whenever one comes across them in reading, so that the time spent will not be missed; and their usefulness is directly proportional to their number, completeness not being essential.

If the library is catalogued the pamphlets can be numbered the same as books, whether they are kept separate or bound together in volumes of convenient size. For small special libraries it is well for the owner to devise his own classification, for the subject classifications in common use may not be detailed or up-to-date enough for his purposes. For example, Dewey's decimal system, which seems to be the favorite one with public libraries in this country, lumps geography and history together, arranges the families of plants by the Bentham and Hooker system, which was abandoned by most botanists about twenty years ago, and provides only one number (634.9) for forestry, which has become a pretty complex subject in recent years.

For taking care of the pamphlets on the shelves there are several methods, some of which are mentioned by Mr. Storer and some are not. The most logical is to put each one that is not part of a series in separate stiff covers, which can be done quickly and cheaply by means of some devices that are on the market. The principal objections to this method are that it more than doubles the bulk of the average author's separate, and unless the gum on the binding strips is supplemented by staples or stitching the pamphlet is liable to become detached from its paper cover or outer pages after a little handling. Furthermore, with thin pamphlets standing on shelves the titles can not be read without pulling them out a little way. A compromise might be made, however, by putting separate covers only on those exceeding a certain thickness, say a quarter of an inch.

Binding a number of pamphlets together, unless they belong to a closed series or are all on one subject, by the same author, and of the same size, is almost sure to lead to regrets later. For as a library grows or the owner's interests become more specialized its contents will need to be classified more and more minutely, and papers once thrown together will preferably be separated. And it is exceptional too for a bunch of independent pamphlets on the same subject to be of so nearly the same size that they can be trimmed alike to make a smooth-edged book.

For a growing collection of pamphlets on a given subject, not yet numerous enough to bind into a volume, or for current numbers of serials, there are various kinds of temporary bindings, suitable for reference libraries that have several dozen users. One of the cheapest of these consists of a pair of flexible pieces of cardboard of proper size, with two to four holes reinforced with metal eyelets near one of the vertical edges, and a small shoestring to go through the holes. Each pamphlet is then perforated with an awl, to correspond with the holes in the covers, and they are tied together with the string. The awl-holes do not weaken the pamphlets, and are scarcely noticeable after the collection is bound into a book. But such an outfit makes a rather ragged appearance, and the title can not very well be marked on the back of it. A more temporary method, that consumes less time and mutilates the pamphlets less, uses a piece of stiff paper for a cover, held on by a pair of strong spring clips. These, however, do not allow much variation in thickness, so that one using them at all must keep a large stock of assorted sizes on hand.

Pasteboard pamphlet cases of the type recommended by Mr. Storer (and also by Witmer Stone in SCIENCE for July 14, 1905, p. 53) are most convenient for private libraries and those that are used by only a few persons, all of whom can be trusted to put things back promptly and in the right places after using them. As a rule they should be large enough to hold both quarto and octavo pamphlets. (Those larger than quarto are best bound separately, for otherwise they are liable to be damaged if stood on end for any length of time.) Smaller sizes may be used to advantage for holding current numbers of octavo periodicals or bulletins, and also to contain complete volumes of the same, if the expense of binding is prohibitive and they are not likely to be used much. It is a good idea to have in each pamphlet case devoted to a particular region or subject a large envelope in which can be kept photographs, newspaper clippings and manuscript notes pertaining to that subject, for ready reference, instead of keeping such things in separate departments, as is commonly done.

I heartily endorse Mr. Storer's recommendation that all pamphlets should be marked with the date of accession; with the amendment that the practise should be extended also to periodicals, but is not important in cases where the publications are known to be several months or years old when received. Scientific publications dated a few weeks or months earlier than the facts warrant are deplorably common nowadays, and hereafter whenever the date of a book or magazine is suspected to be wrong the author, editor or publisher should be challenged to produce witnesses who can testify to having received it on or about the actual date of distribution.

Authors who order separates of their papers can lighten the burdens of librarians and other recipients considerably by insisting on a few simple precautions, until all printers of scientific publications get in the habit of doing the right thing without special orders. Some printers who ought to know better make separates by simply ripping the magazines apart, and if a paper happens to be unsymmetrically disposed with respect to the middle of a signature some of its leaves will then be separated, and must be fastened with paste or lateral staples, making a pamphlet that will not open out flat and is awkward to bind with others.

Every reprint from a serial should show on its cover or in some other appropriate place the volume number, page numbers, and date (not only year but month), so that it can be cited correctly without the original. If the original pagination is retained, as is usually (and ought nearly always to be) done, no additional statement about the page-numbers is necessary. Some reputable magazines still issue reprints without any indication of the volume-numbers, however, and such omissions encourage the common slipshod practise of giving incomplete citations in bibliographies. The volume number should be in Arabic figures, regardless of ancient traditions or the usage of the magazine, to save the reader the annoyance of translating the obsolescent Roman numerals which some periodicals still inflict on their readers.

The first page, or cover as the case may be, of a reprint should always bear the title and in most cases the author's name, besides the name of the magazine, etc. In sorting out large piles of pamphlets I have many times been provoked by having to stop and look inside one with a blank cover to see what it was about; and three times within the past year I have received from different printers (who had not previously done work for me) separates in which the article began on a left-hand page (which could not be foreseen when I read the proof) and the first page was left blank, necessitating writing the titles by hand or having it done by a local printer.

In ordering reprints from SCIENCE authors can accommodate their friends with no extra trouble to themselves (for they are given the choice) by having them made up in single-column or octavo form, unless they contain tables or diagrams that extend across both columns. For articles in SCIENCE do not usually make many pages, and if reprinted in the original quarto form they are rather thin, and easily torn or crumpled when filed in a case

with octavo pamphlets. The publishers of some other periodicals are equally accommodating, and I have had quarto and octavo reprints made from one that has folio pages, with no extra charge.

Even before an article is set up the author can take some precautions for the benefit of his readers. It would be too much of a digression to point out many of them here, for this is not an essay on how to prepare manuscripts for publication;[2] but attention might be called to one desirable reform, namely, restricting the number of joint contributions. Every book or paper by two or more authors, especially if new species are described in it, makes extra trouble for librarians, bibliographers, biographers and others, as long as a copy of it exists (which may be for several centuries). Usually most or nearly all of the writing of a joint paper is done by one of the authors, and the assistance of the other can be fully acknowledged without putting his name on the title-page. In cases where one author is much older or better known than the other the latter doubtless feels honored in having his name publicly associated with the more noted man's; but reputation is a scientist's most precious possession, and no true scientist should wish his to be mixed with any one else's. (Nearly all the great masterpieces of science are each the work of one man.)

For the benefit of librarians I will close with a protest against the common custom of discarding the covers and advertising pages of magazines when they are ready to be bound. The stock excuse for this is that it is done to save space; but few scientific libraries are so cramped for space that they can not spare a few inches more a year for advertising pages. It is very interesting to look through the outer pages of old numbers of Science, for instance, and see what text-books and apparatus were in use at a given period, and sometimes one can get valuable evidence of dates of publication in that way.[3] There is perhaps no better place than the advertising pages of the popular literary magazines to trace the historical development of bicycles, automobiles and innumerable other familiar articles.

Covers help to locate articles in a volume quickly when one knows the month but not the page, and they often bear dates, tables of contents, and other information that is not given in the magazine proper. On the third cover page of the *American Journal of Science* for January, 1877, an important astronomical discovery was announced, but those who do not preserve the covers can trace it back only to the February number, where it was printed again on the regular pages. Early in the history of the same magazine the covers of some of the numbers bore a list of places where it was kept on sale, which is of considerable interest, including as it does some towns that have now almost disappeared from the maps.

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[2] For some valuable suggestions along this line see W. M. Davis, *Pop. Sci. Monthly*, 78, 237–240, March, 1911.

[3] See *Torreya*, 7, 170 (footnote), Aug., 1907.

SPECIAL ARTICLES

EXPERIMENTS ON MOTOR NERVE REGENERATION AND THE DIRECT NEUROTIZATION OF PARALYZED MUSCLES BY THEIR OWN AND BY FOREIGN NERVES

During the past three years, I have been investigating the question of the physiological regeneration of motor nerves when directly implanted into paralyzed muscles, and the possibility of the reestablishment of normal neuro-motor connections. In these experiments a remarkable difference in the behavior of the muscles' own nerve and that of foreign nerve was found.

The experiments were made upon the nerves and muscles of the thighs of rabbits. For the electric stimulation a weak current from a Porter induction coil was used, and the nerves and muscles were always freely exposed, so that the effect of the direct stimulation of one or both could be carefully controlled. It is hardly necessary to state that experiments of this kind must be done with great care, that regeneration of divided nerves must be prevented when so desired by extensive resections of the nerves, and that the operator must be certain

that the muscle has been paralyzed by the division of all of its nerve supply. In all of the experiments, unless otherwise stated, the central connection of the nerves remained intact.

1. In the first series of experiments all of the branches of a nerve to a muscle were cut and then reimplanted into the same muscle. In the second series, after the wide excision of all of the nerves to a muscle, a motor nerve which supplied another muscle was cut and implanted into the paralyzed muscle.

It was found in all these experiments that after from eight to ten weeks, electric stimulation of the implanted or the reimplanted nerve was followed by a good contraction of the muscle.

Conclusion.—In agreement with Heineke, Erlacher and Steindler, direct neurotization of a muscle paralyzed by separation from its motor nerve supply is possible. After eight to ten weeks, the connections between the nerve and the muscle fibers have been reestablished.

2. Eight weeks after the resection of all of the nerves to a muscle, the wound was reopened and the muscle was examined. The muscle appeared pale and shrunken, and would not contract or would contract only very weakly upon direct stimulation by a strong electric current. A motor nerve from another muscle was then divided and was implanted into the atrophied muscle.

Eight to ten weeks later the muscle had regained its normal appearance, and electric stimulation of the implanted nerve was followed by a good contraction of the previously atrophied muscle.

Conclusion.—Neurotization of a muscle which has been deprived of its nerve supply for many weeks is possible. The muscle tissue regularly regenerates under the influence of the regenerating motor nerve which has been implanted.

3. (*a*) Into a muscle with its nerve supply intact, the motor nerve from another muscle was implanted.

Eight to ten weeks later, stimulation of the normal motor nerve to the muscle caused a good contraction, while stimulation of the implanted nerve was without result.

(*b*) The normal nerve to the muscle was then widely resected and the wound closed. When the wound was reopened eight to ten weeks later, the muscle had a normal appearance, and the normal nerves to the muscle had not regenerated. Now, however, a powerful contraction of the muscle followed the electric stimulation of the implanted nerve.

(*c*) In a few of the experiments described under (*a*) stimulation of the implanted foreign nerve caused a contraction of the muscle, but the muscle could no longer be made to contract when its normal nerve was stimulated.

Conclusions.—Hyperneurotization of a normal muscle is impossible. *A normal muscle can not be made to take on additional nerve supply.* The implanted nerve can not make any neuro-motor connections and its stimulation will usually fail to have any effect upon the muscle. *If, however, the muscle is permanently separated from its original nerves, then the implanted nerve—which had been hitherto unable to form a connection with the muscle fibers—will establish neuro-muscular connections, and electric stimulation of the nerve will soon cause normal contractions of the muscle.*

4. (*a*) The same experiment as in No. 3 (*a*) was performed, namely, the motor nerve from another muscle was implanted, and in addition the normal nerve to the muscle was cut outside of the muscle and the ends of the cut nerve at once united again by suture.

After eight to ten weeks, stimulation of the implanted nerve was without result, while stimulation of the normal nerve to the muscle (which had been divided and at once united by suture) either above or below the point of division caused a good contraction of the muscle.

(*b*) Both the foreign implanted nerve and the normal nerve to the muscle were cut and the ends of each at once united by suture.

After eight to ten weeks, electric stimulation of the normal nerve either above or below the point of division and suture, caused a contraction of the muscle. Stimulation of the implanted nerve was without effect upon the muscle.

(*c*) The normal nerve was cut near the muscle and was at once reimplanted into another part of the muscle. A foreign motor nerve was also implanted into the same muscle.

After eight to ten weeks, the muscle contracted upon stimulation of the normal (reimplanted) nerve, but not upon stimulation of the foreign (implanted) nerve.

Conclusions.—Under similar conditions, the normal nerve to a muscle will regain its motor connections with the muscle fibers and will in some way prevent a foreign nerve which has been implanted at the same time from making any effective neuro-muscular connections. It is impossible to state whether this is due to a more rapid regeneration of the normal nerve or to the fact that the regenerating normal nerve has an inhibitory influence upon the intramuscular regeneration of the foreign implanted nerve. The axis cylinders of the normal nerve to the muscle seem to be able to reestablish their former connections with the end plates or bulbs or to form new end organs more quickly or more powerfully than do those of a nerve which had belonged to a different muscle.

These experiments prove that if a muscle has once its normal nerve supply no other motor nerve is able to make neuro-muscular connections with the same muscle; and that if the normal nerve is cut and reimplanted into a muscle and at the same time a foreign motor nerve is also implanted into the same muscle, only the former will make neuro-muscular connections. The experiments are being continued.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION B—PHYSICS

The recent, December 26–30, 1916, meetings of Section B of the American Association for the Advancement of Science were, as usual, held jointly with the American Physical Society. President R. A. Millikan, of the Physical Society, and Vice-president H. A. Bumstead, of the American Association for the Advancement of Science, alternately presided.

The address of the retiring vice-president of the association and chairman of Section B, Dr. E. P. Lewis, printed in full in Science, December 29, 1916, was an admirable summary of the numerous researches and important discoveries recently made in spectroscopy.

The symposium held jointly with Section C, was on the "Structure of Matter." The eight invited papers together with their formal and informal discussions occupied an entire day, and aroused exceptional interest. Indeed the interest was so pronounced that it has been decided to have as many as possible of the formal papers published in Science.

Other matters of interest to physicists were: some 60 technical papers, representing a wide range of investigations, presented and discussed at the joint meetings of Section B and the Physical Society; recent additions to the equipment of the laboratories of Columbia University; exhibits of apparatus and results loaned some by other universities, and some by manufacturers; and the usual physics dinner.

The number of physicists that attended these meetings was unusually large, but should have been even larger. No scientist can afford habitually to ignore these great gatherings of creative workers, nor can any university afford to tolerate such apparent indifference—for the reputation of a university is the reputation of its faculty and nothing more.

Just before adjourning a well-deserved vote of thanks was extended to the officers and faculty of Columbia University for their courteous hospitality that so materially had contributed to both the pleasure and the success of the meetings.

At present the officers of Section B are as follows:

Vice-president and Chairman of the Section: W. J. Humphreys, Weather Bureau, Washington, D. C.

Secretary: G. W. Stewart, State University of Iowa, Iowa City, Ia.

Member of Council: P. G. Nutting, Kodak Research Laboratory, Rochester, N. Y.

Sectional Committee: Vice-president, New York, H. A. Bumstead; Vice-president, Pittsburgh, W. J. Humphreys; D. C. Miller, one year; G. W. Stewart, two years; R. R. Tatnall, three years; W. S. Franklin, four years; C. W. Waggoner, five years. *Ex-officio:* R. A. Millikan, President, American Physical Society; A. D. Cole, Secretary, American Physical Society.

Member of General Committee: G. F. Hull, Dartmouth College.

W. J. Humphreys,
Secretary